

Human Factors Standardization SubTAG

Minutes

May 2011

TAG #65

The Human Factors Standardization (HFS) SubTAG held a double session on May 3, 2011 with 35 attendees. Following the introduction of attendees, the SubTAG continued with its agenda.

Status Reports:

a. MIL-STD-1472, Human Engineering. Dr. Daniel Wallace reported that the draft of the G revision has been circulated for formal review and comment. Changes in the "G" revision include modifying the document structure and grouping of related requirements; incorporating extensive material from MIL-HDBK-759C; updating figures and tables; changing soft requirements ("should") to hard requirements ("shall") where appropriate; modifying criteria wording as necessary to be more direct; splitting multiple requirements into individual statements where appropriate; correcting errors present in MIL-STD-1472F; removing obsolete content and references (e.g., old technologies); adding additional references; and hyperlinking the table of contents, tables, figures, and embedded references to sections.

It was noted that updating MIL-STD-1472 presented some of the challenges. Among these were the amount of time that passed since the last major technical revision, provisions for which there were no sources, paragraphs to be rewritten to reflect performance-based provisions, document compliance with the requirements for drafting a standard (i.e., MIL-STD-962D), limited resources to accomplish the work within the allotted time, and the broad scope and the length (material was incorporated from MIL-HDBK-759C) of the document.

The "G" revision is in the final stages of adjudicating comments. It is anticipated that the final version will be sent to the Preparing Activity for approval before the end of the fiscal year.

There were a number of topics that were beyond the time and resources available for the "G" revision; these are being deferred to the "H" revision. These include areas that were too complex to be easily addressed, areas that required a more in-depth review of the literature, and areas in which data are needed to fill gaps.

Dr. John Warner indicated that the Army is revamping Army Regulation (AR) 602-2, *Manpower and Personnel Integration (MANPRINT) in the System Acquisition Process*. The regulation is being revised to update the language, provide a better definition of organizational roles, and strengthen the requirements (use of "shall" statements). The document is currently at the printers.

b. MIL-STD-2525, Common Warfighting Symbology. Dr. Jake Wetzel was unable to attend the meeting, but indicated that the "D" revision is in the final stages of preparation. It is envisioned that the draft will be circulated for formal review and coordination by the end of the Summer with publication by the end of 2011. MIL-STD-2525D will have chapters for each battle domain: Air, Space, Sea Surface, Subsurface, and Land assets. A revised symbol ID code (SIDC) is being created. The SIDC is being changed from a 15-digit character string to two 10-digit number strings; the first 10-digit string describes the symbol's frame and dimension while the second 10-digit string describes the symbol's icon and associated modifiers. In addition, a new building block approach is being used for symbol construction based on the symbol frame plus icon plus modifiers. By describing the methodology for designing symbols, and not having to portray every icon/modifier combination, it is anticipated that the document size can be reduced to almost half the size of the "C" revision.

c. NASA-STD-3001, NASA Space Flight Human System Standard. Ms. Mihriban Whitmore provided a status update on the NASA standard. Volume 1, Crew Health, of NASA-STD-3001 was approved in March 2007. The accompanying Human Integration Design Handbook (NASA/SP-2010-3407) was approved in January 2010. Volume 2, Human Factors, Habitability and Environmental Health, was approved in January 2011. Collectively, Volume 1, Volume 2, and the Human Integration Design Handbook become NASA-STD-3001 and supersede NASA-STD-3000. NASA-STD-3001 is intended as an agency-level standard that applies to anything that is to be integrated. The handbook provides general and specific design criteria which are to be tailored for the particular program.

d. Federal Aviation Administration (FAA). Mr. Alan Poston indicated that the FAA is in the process of updating its Human Factors Design Standard. The goal is to have an updated version published in 2014. The FAA is currently exploring contractual mechanisms that can be used to reach the various content developers needed to achieve the update.

e. Flight Symbology Working Group (FSWG). Mr. Bob Copeland was unable to attend the meeting but indicated that plans are underway for a possible FSWG meeting later this year (pending FY 12 funding information). However, even if a meeting is not feasible, the prospect of a "community of interest" forum is being investigated. In this way, one can start a moving dialogue and share information in a meaningful way.

f. MIL-STD-1787, Aircraft Display Symbology: Mr. Bob Copeland was unable to attend the meeting but indicated that the Army submitted some technical comments to the final draft of the "D" revision. The working group is in the process of addressing those comments. Once completed, the document will go forward for signature. The document will then go out for formal coordination. Publication is planned for Spring 2011.

g. Revision of Data Item Descriptions (DIDs): Mr. Steve Merriman reported that DI-HFAC-81833, *Human Systems Integration Report*, was approved on March 2 and DI-HFAC-81743A, *Human Systems Integration Program Plan*, was approved on April 21. Both documents have been posted in the Acquisition Streamlining and Standardization Information System (ASSIST) database. Mr. Merriman indicated the next DID to be tackled will be the DI-HFAC-81742, *Human Engineering Program Plan* followed by the two Human Engineering Design Approach Document DIDs.

h. MIL-STD-46855A, Human Engineering Requirements for Military Systems, Equipment, and Facilities. Mr. Alan Poston reported on an effort to reinstate MIL-STD-

46855; the standard was converted to a handbook during acquisition reform. A revised standard was drafted and circulated for formal review and comment in September 2009 under project HFAC-2009-001. All comments were adjudicated and the final document was sent to the Preparing Activity in February 2010.

As MIL-STD-46855 was converted to a handbook as a result of acquisition reform, reinstatement as a standard requires approval by the Defense Standardization Council (DSC); this is the first document that is seeking reinstatement. The Departmental Standardization Offices (DepSOs) were briefed on April 27, 2010; no opposition was raised. Mr. Welby, the Defense Standardization Executive, wants a process in place for handling reinstatements; MIL-HDBK-46855 is the test case for such a process. A business case analysis was conducted and recommended reinstatement. The process is still being debated. The Defense Standardization Council meets on May 6 and the reinstatement of MIL-STD-46855 is on the agenda. It is anticipated that, without objection, the reinstatement will be approved.

Presentations:

ANSUR II: Anthropometric Models to Optimize the Human Systems Interface. Dr. Claire Gordon gave an update of the current effort to capture anthropometric measurements from Army and Marine Corps personnel. Dr. Gordon noted that everything a soldier wears, carries, flies, drives, rides in, works in, and sleeps in depends on anthropometry. U.S. Army anthropometric surveys have been conducted since the Civil War. Anthropometric tariffs are used for purchasing and stocking sized items. Variations by item and sometimes by supplier occur when sizing systems are not standardized.

Most clothing and individual equipment were designed and sized based on the 1988 anthropometric survey database. There were critical shortages in larger sizes of Joint Service Lightweight Integrated Suit Technology (JSLIST) and Interceptor body armor. Special order requirements for sizes not normally stocked were excessive. Operation Iraqi Freedom body sizes exceeded existing accommodation envelopes causing soldier-system integration problems and tariff shortages. A pilot study of approximately 2,800 Active, Reserve, and Guard males conducted at Fort McCoy and Fort Hood concluded that the current Army body sizes are outside the range of the 1988 database and need to be updated.

The objectives of the anthropometric survey II (ANSUR II) are to update the active duty database; add a National Guard database; and add 3-D scans of the head, foot, and body. Additional objectives are to prepare summary statistics, accommodation requirements, and clothing and individual equipment tariffs; statistically optimize models for sizing combat clothing and equipment; and statistically optimize a family of 3-D digital human models for computer-aided design of aircraft, ground vehicles, and workstations.

Measurement of Marine Corps personnel have been completed; 1,898 Marines were measured. Measurement of Army personnel began in October 2010 and is planned to continue through February 2012.

ANSUR II payoffs include a valid anthropometric criteria for requirements documents; an efficient design, sizing, and tariffing of clothing and individual equipment and hardware; reduced risk of human factors failures in fast track acquisitions and multi-component

ensembles; improved operational readiness by integrating Guard and Reserve requirements throughout the materiel life cycle; and new 3-D capabilities to integrate shape data in the design of body armor and close fitting protective equipment.

Standards in Modeling and Simulation. Dr. Andrew Collins gave a presentation on some work that is being conducted at the Virginia Modeling, Analysis, and Simulation Center (VMASC) at Old Dominion University. With the emergence of new and more powerful computer technology and techniques means that modeling and simulation has become an important, and growing, part in satisfying this requirement. As an industry grows, the benefits from standardization within that industry grow with it.

Dr. Collins indicated there are a variety of standards including de facto, voluntary, de jure, implicit, and explicit. A key aspect is to balance the implementation of standards against innovation. In any discussion of modeling and simulation, there is the likelihood of confusion of the terms being used. A model is "a physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process" while simulation is "a method for implementing a model over time."

Dr. Collins noted that the DoD has used modeling and simulation for the last 30+ years for system engineering and acquisition, training, analysis, experimentation, planning, and testing. However, modeling and simulation is poised to rapidly grow beyond DoD in the years ahead. Cost considerations demand reuse and interoperability of modeling and simulation in as many areas as possible. For various reasons, research and development of modeling and simulation has not produced broad classes of interoperable, multi-domain models. Among the reason for this are proprietary architectures, lack of consistent and clearly defined development standards protocols for data structure and exchange, model resolution and scalability issues that computer science and software engineering have yet to overcome, counterproductive incentive structures in the contracting arena, and limited executable architectures and interfaces for federating models.

Dr. Collins described a series of workshops being conducted by VMASC. The first workshop, "The Next Ten Years," was conducted in March 2010 and discussed key challenges, key standards development, and the complexity of modeling and simulation. The second workshop, "Governance," was conducted in August 2010 and discussed existing processes, leadership, and glossary. The third workshop, "Healthcare," was conducted in January 2011 and discussed growth and agent-based modeling and simulation. The fourth workshop will be held in May 2011 (actually the week after the TAG) and will discuss standards as tools and objects.

An Overview of the New England Chapter of the Human Factors and Ergonomics Society (HFES). Mr. Eric Jones gave an overview of the activities of the New England Chapter of HFES. The Chapter, founded in 2000, connects students and professionals in human factors, psychology, and engineering disciplines throughout the New England region. It also serves as a link between academia and industry. The Chapter has 140 total members; about half of which are associates (professionals in the area) and half are students. Ten different universities and campuses are represented.

Every month or two, the Chapter hosts a technical speaker, site visit, or social event. Last year, the Chapter held an annual student research conference. It was attended by about 80 human factors professional and students; about 20 student presentations were given on topics such as human factors in space, transportation, education, health care, and aging.

Assessing Human Factors Engineering Products Using a Requirements Parsing

Tool. Dr. Suzanne Dawes gave a presentation on a requirements parsing tool developed by The Aerospace Corporation. Technical reviews need to communicate both the adequacy and shortfalls of the designated products to facilitate effective action. Technical reviews should be comprehensive and complete; include the appropriate technical expertise; identify areas where the products exceed, meet, require change, and do not meet contractual requirements; and identify human factors risk areas to program management. Dr. Dawes noted a need to have a consistent approach to complete technical reviews of human factors engineering products; a method for tracking metrics in order to compare products, from version to version, or program to program; and the ability to easily identify areas requiring further development or additional review (risk areas).

The human factors engineering products being assessed are the human engineering data item descriptions (DIDs) placed on contract. The purpose of the tool is to evaluate the completeness and technical quality of the product content, ensure all requirements in the DID are adequately addressed, and provide a means for collecting metrics to evaluate improvement. It was emphasized that the tool does not replace the required knowledge and technical expertise of reviewers.

The assessment process consists of experienced human factors personnel to perform evaluations using the computer-based tool. Individual evaluations are consolidated into a single matrix based on discussions of individual ratings. The final evaluation matrix produces automated charts showing overall content quality and specific risk areas that require modification. Comment sections in the tool are used to document comments for the official Comment Resolution Matrix that is delivered to the contractor.

The evaluation tool has a number of benefits. It allows a comparison and measurement (in quantifiable terms) of improvement between versions of the product, can highlight risk areas that require further development, and can compare different programs. The tool provides the reviewers with an easy way to review the product against contractual requirements, allows for partial review, improves the ability to reach consensus on the completeness and quality of the product, supports a thorough yet faster review, and results in an increase in both the number and detail of the comments provided (as compared to previous reviews).

The next steps are to continue to use tool for current and future product reviews, and explore the benefits of providing the tool to contractors to facilitate their internal quality and risk review prior to delivery to the government.

Dr. Dawes gave a demonstration of the contract data requirements list (CDRL) evaluation tool using a hypothetical Human Engineering Program Plan (HEPP) DID. She demonstrated how the tool would be populated, the outputs that could be obtained, and how the tool would be used in determining the adequacy and compliance of the DID as applied to a particular program.

A Draft Air Force Human Systems Integration Guidance Document. Dr. Bill Kosnik gave an update of the Air Force's adoption of the UK Ministry of Defence (MoD) Human Factors Integration (HFI) standard, Defence Standard 00-250, *Human Factors for Designers of Systems*, published in May 2008. The goal is to provide a set uniform human systems integration requirements, design guidance, and associated human factors data for

acquisition programs Air Force wide. Dr. Kosnik indicated the thrust of this effort is to use the UK Defence Standard 00-250 as a prototype for rapid transition to an Air Force HSI guidance document. The overall plan is to convert UK HFI language into DoD HSI language, convert references to US standards using "pointers" to the comparable US and DoD human factors research, references, and standards, and collaborate with the other services and the international community.

An internal review of all five volumes of the guidance document has been completed. The next step is to distribute the draft to the Human Performance Team for review. A question was raised about industry participation in the review. Dr. Kosnik indicated he would welcome industry participation and would use the Survivability Information Analysis Center (SURVIAC) and the Technical Society/Industry (TS/I) SubTAG to obtain industry input.

The plan is to initially publish the draft as a Human Performance Wing (HPW) guidance document within the next month or two. A follow-on effort is planned which will convert the HPW document to an Air Force guide for the application of human systems integration in acquisition contracts. The ultimate goal would be to convert the document to a DoD standard but resources for this step have not been identified.

Future versions of the guidance document will "beef up" some of the areas that are weak in the UK standard. These areas include survivability, habitability, and environment.

Space and Naval Warfare Systems Command (SPAWAR) Human Systems Integration (HSI) Instruction. Presenting for Dr. Robert Smillie, who was unable to attend, Mr. Alan Poston gave a presentation on a SPAWAR Instruction aimed at establishing policy and assigning responsibility for the planning and execution of HSI. The Instruction (SPAWAR Instruction 5238.5 (Draft), *Team SPAWAR Human Systems Integration (HSI) in Acquisition and Modernization*) would apply to all SPAWAR activities designing, developing, evaluating, or modernizing systems across the system life cycle. The Instruction includes an enclosure on HSI requirements extracted from the draft MIL-STD-46855.

Supporting the Instruction is an HSI handbook. In 2009, SPAWAR received permission to copy portions of the Ministry of Defence (MoD) British Defence Standard (BDS) 00-250. Later that year, SPAWAR issued an internal document incorporating approximately 360 pages of the BDS 00-250 with Americanized language. The handbook is a revised compilation of the earlier 2009 material.

The purpose of the handbook is to provide HSI task guidance; describe the significance of the analysis, design, and test aspects of HSI; outline effective procedures for implementing the guidance; and provide summaries of methods and tools. Chapter 1 is an introduction while chapters 2 – 7 provide HSI guidance intended to support all acquisition contracts, including equipment and supply of services.

Chapter 2 defines a set of general methods and techniques that HSI practitioners use to identify the factors that must be considered when designing a system. Chapter 3 provides an overview of various tools and techniques that a system developer can use in designing, testing, and demonstrating a solution approach. Chapter 4 provides information and technical guidance on human characteristics. Chapter 5 refers the reader to MIL-STD-1472F/G (*Human Engineering*) and MIL-HDBK-759 (*Human Engineering Design Guidelines*). Chapter 6 provides information and technical guidance for the management and control of the physiological environment within enclosed workspaces, and the control of the user's

personal equipment for non-enclosed workspaces. Chapter 7 provides information and technical guidance on the design of equipment including displays, controls, interfaces, and operational facilities within workspaces.

Anyone having questions regarding the SPAWAR Instruction or accompanying handbook should contact Dr. Bob Smillie at robert.smillie@cox.net

Occupant Centric Survivability. Ms. Dawn Woods stated that Occupant Centric Survivability (OCS) is a Tank and Automotive Research Development and Engineering Center (TARDEC) initiative to influence the design of combat vehicles to increase human survivability in blast, crash, or rollover events. Efforts include incorporating new technology into the design of these vehicles and leveraging information into existing design standards such as MIL-STD-1472. There is potentially an opportunity to fund efforts to explore and update areas of interest to both OCS and MIL-STD-1472 as well as address data voids. Some of these areas might include whole body vibration and G-loading, thermal stress, passageway minimum clearance, and noise during operations at night or in darkened conditions; it was noted that this is not a comprehensive list. Organizations who have interest in pursuing areas of interest to OCS are encouraged to contact Ms. Woods at dawn.woods@army.mil

The Impact of Acquisition Reform on Human Factors Standardization. Mr. Alan Poston gave an overview of the impact that acquisition reform had, and continues to have, on the human factors standardization area. Secretary of Defense William Perry's memorandum of June 1994 stated the priority for the use of specifications and standards for acquisition programs is performance specifications, non-government standards, and, as a last resort, military specifications and standards with an appropriate waiver. Industry complained that the imposition of military specifications and standards was restricting innovation, limiting creativity, and eliminating one's competitive edge; MIL-STD-1472 and MIL-STD-46855 were cited by industry as a cost drivers.

A study conducted by Coopers and Lybrand cost premiums estimated that inclusion of human engineering requirements added a cost premium of 0.5 percent to the research and development (R&D) cost of an acquisition program. While there may be an increase in the R&D cost, there will be greater savings in operations and support costs thereby reducing total program costs. Later studies by Rand Corporation suggest the Coopers and Lybrand review may have overstated costs by as much as six-fold.

As a result of acquisition reform, the number of human factors standardization documents was reduced from 21 to 11; the other 10 were canceled. Four were handbooks, three were converted to handbooks, two were designated as Design Criteria Standards (thereby requiring a waiver), and two were designated as Interface Standards.

Human factors standards were, in essence, reduced to guidance. Funding for standardization activities has gone to zero and is slow to return. The discipline removed from the acquisition process in that there is a perception that contractor oversight is not needed and the Government has little recourse for contractor's failure to perform. The cost of complying with stated requirements is small compared to the cost of overruns; cost overruns and schedule delays are rarely the result of cumbersome acquisition regulations. The bottom line is that fewer requirements mean less program visibility, and fewer problems will be uncovered in time to solve them.

Other Business:

MIL-STD-1472 Checklist. In 1995, Lockheed Missiles and Space Company produced a checklist for MIL-STD-1472D. At the October 2010 SubTAG meeting, Ms. Teresa Alley indicated that she has been tasked to look at the prospect of updating that checklist using MIL-STD-1472G as the basis. Though unable to attend this meeting, Ms. Alley drafted a proposed approach for developing a checklist. The consensus of the SubTAG was to develop the checklist using several limited portions of MIL-STD-1472G; several people volunteered to apply the checklist and provide feedback. Until one actually attempts to apply the checklist, the utility of such a tool is unknown. Ms. Alley was provided a draft of the "G" version so she can see the document organization and structure.

Re-publishing of the Human Engineering Design Data Digest. The Human Engineering Design Data Digest, affectionately known as the Pocket Guide, was last published in 2000; funding was provided by the Federal Aviation Administration. Copies were provided to the three Services. The Defense Technical Information Center (DTIC), San Diego, would provide copies upon request. In addition, DTIC personnel would distribute copies at conventions, technical society meetings, and trade shows.

The Pocket Guide is designed to slip into one's "pocket" when going to the field and provides a quick reference source of data. SubTAG attendees agreed that an update would be beneficial. With MIL-STD-1472G to be published later this year and the recently approved NASA-STD-3001, the time may be right for the Pocket Guide to be updated.

Several cost estimates were obtained and the matter of funding the re-publishing of the Pocket Guide was brought to the Operating Board for consideration. A decision by the Operating Board would not be needed before the Fall meeting with the funding provided in the Spring of 2012. Between now and the Fall SubTAG meeting, a group of volunteers will explore the format and content of the updated Pocket Guide.

Definition of Human Factors Engineering. Mr. Alan Poston indicated that while processing the reinstatement of MIL-STD-46855, one of the points of confusion was the difference between "human engineering" and "human factors engineering." MIL-HDBK-1908B, *Definitions of Human Factors Terms*, defines human engineering as "The application of knowledge about human capabilities and limitations to system or equipment design and development to achieve efficient, effective, and safe system performance at minimum cost and manpower skill, and training demands. Human engineering assures that the system or equipment design, required human tasks, and work environments are compatible with the sensory, perceptual, mental, and physical attributes of the personnel who will operate, maintain, control, and support it." It was noted that the various standards, handbooks, and data item descriptions (e.g., MIL-STD-1472, MIL-HDBK-759, DI-HFAC-81742) use the term "human engineering."

The problem came about because DoD and Service policy documents refer to "human factors engineering" but do not define the term. From the practitioner level, the terms "human engineering" and "human factors engineering" are considered to be equivalent. To codify this equivalency, it was agreed to propose the following addition to MIL-HDBK-1908:

Human factors engineering. See "Human engineering."

ATTENDEES

Booher, Clete
Carlson, Kristen
Cole, Shannon
Collins, Andrew
Davis, James
Dawes, Suzanne
Foran, Jack
Ganey, Neil
Gibson, Ben
Gleiter, Roberta
Gordon, Claire
Gray, Dawn
Hawes, Breanne
Jones, Eric
Kaylor, Chuck
Kijora, Christian
Kosnik, William
Maziarz, John
McLean, Debra
McNamara, Jay
Merriman, Steve
Moore, Kristin
Muse Duma, Katherine
Null, Cynthia
Palmer, Barbara
Paquette, Steve
Plaga, John
Portillo, Robert
Poston, Alan
Reid, Christopher
Wallace, Daniel
Warner, John
Whitener, Connie
Whitmore, Mihriban
Woods, Dawn

HFES Liaison
NAS Pensacola - NAMI
U.S. Coast Guard
Old Dominion University
ARL-HRED
The Aerospace Corporation
U.S. Coast Guard
NSWC
Army Medical Dept Center & School
The Aerospace Corporation
Army NSRDEC
U.S. Coast Guard
Army NSRDEC
New England Chapter HFES
NAVAIR
U.S. Coast Guard
Air Force, 711th HPW/HP
Booz-Allen-Hamilton
AF Program Office - Natick Soldier Center
Army NSRDEC
Boeing
SPAWAR
Booz-Allen-Hamilton
NASA NESC
SURVIAC
Army NSDREC
Air Force, 711th HPW/HP
NAVAIR
HFES Alternate Liaison
Army NSRDEC
NSWC Dahlgren
Army MANPRINT Office
Yuma Proving Grounds
NASA Johnson Space Center
Army NSRDEC